POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE
Degree in Architecture
<u>Honors theses</u>

Theoretical and experimental analysis of thermal behaviour of transparent ventilated facades

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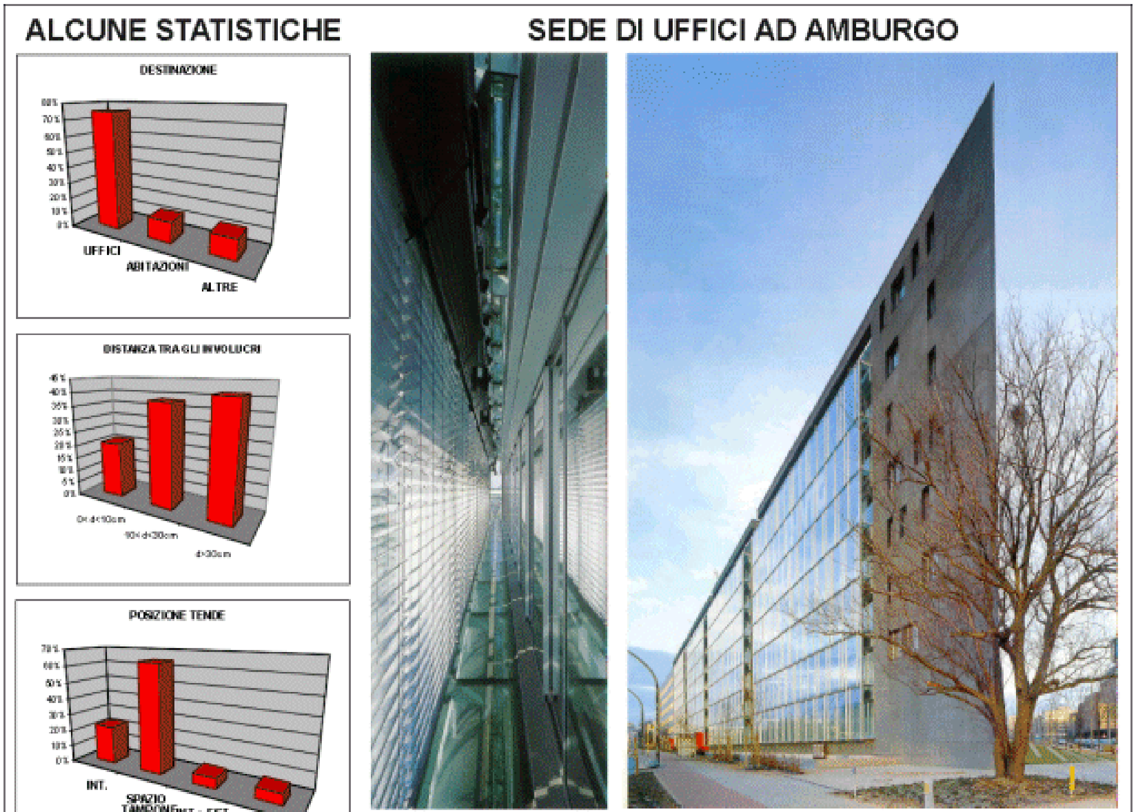
Transparent ventilated façades or "double skin" can be considered an evolution of traditional glass façades, since they are constituted from an internal frontier and an external frontier (both partially or totally glazed) which are separated by an air cavity from 4 to 150 cm.
The realization of double skin façades is generally justified by achievable energy saving, that absorbs greater cost of construction in a short time. This argumentation can be false if the façade project is not integrated with overall project of the building directed to the energy saving and solar energy exploitation.

In order to correctly organize the topic of this thesis the first chapter is dedicated to an analysis on more diffused typologies of double skin realized at present. Subsequently a technological and functional reading of the double skin typology has been carried out. Some statistics have been elaborated as regards prevalent use, more recurrent thickness of cavities, and more common types of solar protection. Moreover, a series of cards holding some significative projects realized in Europe have been compiled. These cards contain principle characteristics of buildings, such as location, architect, year of construction, double skin typology and, where data exists, description of the two frontier components.



Architetto: Hilde Léon e Konrad Wohlhage, Berlino
Anno di costruzione: 1996

Two particularly interesting projects, have been the object of specific deepening: the SNAM fifth palace office and the "Blue building" system patented by Permasteelisa.
A physical-technical analysis of transparent double skin with deepening of utilizable calculation models for closed and ventilated cavities was later carried out. Moreover, the program's algorithm utilized has been analysed more deeply (WIS by holland search center TNO).
From results obtained by simulations on different configurations of double skin façades, some technical cards have been elaborated, where following items in particular are reported:

- graphic schemes with component temperatures
- transmittance, solar factor and net thermical flow, expressed in W/m^2.

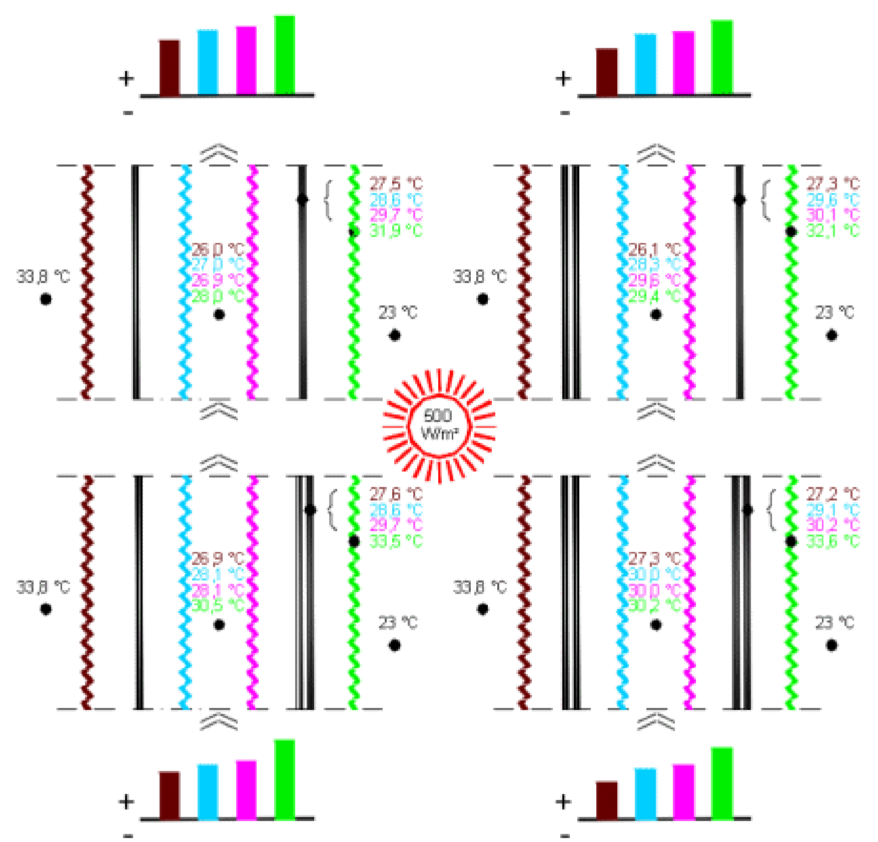
From the analysis of the results some indications have been drawn which are valid for temperate climates and in particular conditions of climatic peaks.
In case of double skins with closed cavity (not ventilated) short distance frontiers of 15 and 20 mm prove to be best in climatic conditions of summer and winter peaks.
Since 150 and 1000 mm double skin solutions are more common, performance comparisons have been made on three dimensions: 150, 500 and 1000 mm. In general, it is useful to underline how increasing distance between glass increases thermical transmittance.

Instead, cavity ventilation distances between 50 and 150 mm appear to be more functional, in terms of thermical transmittance; for successive simulations a distance of 150mm has been considered best, bearing in mind the airflow in smaller cavities at a parity rate of volumetric airflow at higher velocity can be the source of noise or cause of discomfort near small openings. Moreover, a reduced space in the cavity can create difficult installing and functioning of possible screen.

In relation to the position of screen (white curtain) four solutions have been considered in summer peak conditions: indoors, in the cavity at a distance of 50 mm from external frontier, in the cavity at a distance of 50 mm from the internal frontier, outdoors.

The 50 mm choice of distance between screen and glazed component also derives from simulations made.

As foreseeable, the outdoors screen position has provided the best results allowing a considerable reduction of solar factor of double skin.



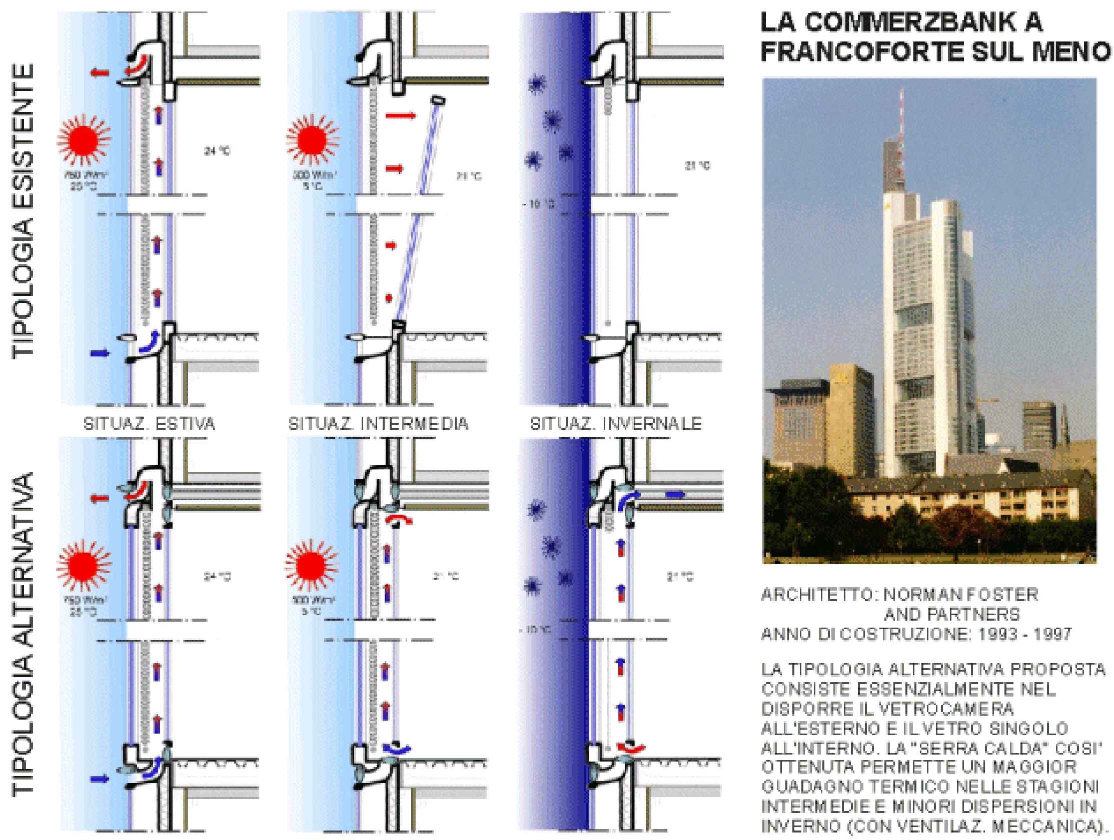
ESEMPIO DI SCHEMA DI CALCOLO, I GRAFICI RAPPRESENTANO I FLUSSI TERMICI USCENTI ESPRESSI IN W/m² RIFERITI ALLA POSIZIONE DELLO SCHERMO

The ventilation strategy plays a predominant part in thermal behaviour of double skins. Four strategies in particular can be pointed out: airflow from indoors and extraction, airflow from indoors and inlet to indoors, airflow from outdoors and extraction, airflow from outdoors and inlet to indoors.

Among these the airflow from indoors with extraction is revealed best in peak conditions; the extraction can be done by forced ventilation through canalization over the false ceiling (or where possible).

In the last part of the thesis a critical reading of the most emblematic projects with ventilated façades regards energy saving in Germany and Switzerland was carried out.

A simulation has been made of double skin typology used on each project. In the light of such considerations an alternative proposal has been made for bettering performance.



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